Preventing chemical risk during transport and unloading of shipping containers

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Preventing chemical risk during transport and unloading of shipping containers

- Introduction
- Gases / Background
- Exposure
- Gas detection
- Container ventilation
- Further steps
Preventing chemical risk during transport and unloading of shipping containers

- Pollutants inside containers:
  - Fumigation gases: phosphine, methyl bromide, etc.
  - Gazes issued from goods: formaldehyde, toluene, benzene, etc.

- Potential occupational exposure at container openings and during occupational activities inside containers: dockers, customs officers, handlers at logistic platforms.

- Procedure for container gases measurement and control

- Development of ventilation techniques for containers
Preventing chemical risk during transport and unloading of shipping containers

In France 5 millions of containers transit in the different ports every year
- 58 Seaports
- 71 River ports

Previous study → 20 % over 5000 controlled containers at the port in Hamburg : evidence of toxic gases (Baur et al., 2010)

<table>
<thead>
<tr>
<th>Port</th>
<th>Year</th>
<th>Nb of Cont</th>
<th>Cont. with warming notice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotterdam</td>
<td>2002</td>
<td>303</td>
<td>1%</td>
</tr>
<tr>
<td></td>
<td>2003</td>
<td>71</td>
<td>NC</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>84</td>
<td>NC</td>
</tr>
<tr>
<td></td>
<td>2005</td>
<td>76</td>
<td>NC</td>
</tr>
<tr>
<td></td>
<td>2006</td>
<td>46</td>
<td>NC</td>
</tr>
<tr>
<td></td>
<td>2008 - 2009</td>
<td>1053</td>
<td></td>
</tr>
<tr>
<td>Rotterdam-Amsterdam</td>
<td>2007</td>
<td>316</td>
<td>NC</td>
</tr>
<tr>
<td>Hamburg</td>
<td>2006</td>
<td>2112</td>
<td>3,60%</td>
</tr>
<tr>
<td>Australia</td>
<td>2007-2008</td>
<td>14943</td>
<td>NC</td>
</tr>
<tr>
<td>Gothenburg</td>
<td>2010</td>
<td>101</td>
<td>0</td>
</tr>
</tbody>
</table>

International studies

Gases / Background

- Fumigants
- Fumigants and gases emit by goods
- Gases emit by goods

<table>
<thead>
<tr>
<th>Description, parameters, data</th>
<th>Formule</th>
<th>CMR</th>
<th>VLEP 8h (ppm)</th>
<th>VLEP CT (ppm)</th>
<th>FT INRS (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phosphine</td>
<td>PH₅</td>
<td>X</td>
<td>0.1</td>
<td>0.2</td>
<td>179</td>
</tr>
<tr>
<td>Bromure de méthyle</td>
<td>CH₇Br</td>
<td>X</td>
<td>5</td>
<td>10</td>
<td>67</td>
</tr>
<tr>
<td>Fluorure de sulfure</td>
<td>SO₂F₂</td>
<td>X</td>
<td>5</td>
<td>10</td>
<td>70</td>
</tr>
<tr>
<td>Acide cyanhydrique</td>
<td>HCN</td>
<td>X</td>
<td>0.1</td>
<td>1</td>
<td>70</td>
</tr>
<tr>
<td>Chloroforme</td>
<td>CCl₃</td>
<td>X</td>
<td>0.5</td>
<td>1</td>
<td>70</td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>CHO</td>
<td>X</td>
<td>1</td>
<td>10</td>
<td>54</td>
</tr>
<tr>
<td>Oxide de méthyle</td>
<td>C₂H₄O</td>
<td>X</td>
<td>1</td>
<td>20</td>
<td>49</td>
</tr>
<tr>
<td>1,2-dichloroéthane</td>
<td>C₂H₄Cl₂</td>
<td>X</td>
<td>5</td>
<td>50</td>
<td>74</td>
</tr>
<tr>
<td>Benzene</td>
<td>C₆H₆</td>
<td>X</td>
<td>10</td>
<td>50</td>
<td>77</td>
</tr>
<tr>
<td>Tolène</td>
<td>C₆H₄</td>
<td>X</td>
<td>10</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td>Xylène</td>
<td>C₆H₆</td>
<td>X</td>
<td>10</td>
<td>50</td>
<td>47</td>
</tr>
<tr>
<td>Styrene</td>
<td>C₆H₄</td>
<td>X</td>
<td>10</td>
<td>50</td>
<td>238</td>
</tr>
<tr>
<td>Monoxyc de carbone</td>
<td>C₆H₄</td>
<td>X</td>
<td>10</td>
<td>50</td>
<td>238</td>
</tr>
<tr>
<td>Dioxyde de carbone</td>
<td>C₆H₄</td>
<td>X</td>
<td>10</td>
<td>50</td>
<td>238</td>
</tr>
</tbody>
</table>

Prevent chemical risk during transport and unloading of shipping containers
Unfortunately, this regulatory element is poorly respected. It is nevertheless the first essential link to warn employees of the potential danger.
Preventing chemical risk during transport and unloading of shipping containers

- On-site tracer gas measurement (port du Havre)
  - tracer gas inside the container
  - homogeneous time
  - gas measurement at different location in the container during degassing phase

- Numerical simulation by the means of Computational Fluid Dynamics software
  - unsteady simulation for airflow and pollutant transport equations
  - airflow analysis outside and inside the container
  - ventilation systems evaluation

- Container ventilation systems and gases measurement methodology validation on site
Preventing chemical risk during transport and unloading of shipping containers

Active mode
Use of a sampling probe through the container door and seals
- Measurement position: high, low, corner
- Sampling depth
- Sampling flow (sampling time)

Passive mode
Door opening in order to place the sampling probe inside the container
→ operator protection to be considered

Rmq: the different suppliers can offer sampling probes and equipment with quality and ease of use depending on the brands.
Preventing chemical risk during transport and unloading of shipping containers

- Mechanical ventilation
  - Light system
  - Half-door system
  - Ventilation process ending at 10% of TLV (to be defined in function of the gas)

- Gas detection
  - Approx. airflow rate 600 m³/h
  - Real-time degassing sampling
  - Approx. airflow rate 1500 m³/h
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Forced ventilation

→ Degassing process function of ventilation airflow rate (reduction by a factor of 3)

→ Inlet above the load

Natural ventilation

→ Variation due to wind speed (+), wind angle (++)

→ 30 min minimum

→ Risk at door openings
Preventing chemical risk during transport and unloading of shipping containers

- Ventilation time in container can be reduced using forced ventilation
- The air needs to circulate in the container
- Evaluation of the gas detection limits
- Risk of worker exposure when opening the doors
- Improved labeling of fumigated maritime containers would reduced the measurements and the risk of worker exposure
- An action in standardization would make it possible to modify shipping containers in order to adapt more effectively ventilation and sampling systems.

Gas and Ventilation Detection Methodology for Maritime Containers

3 axes:
- Qualification of the operator exposure in charge of container unloading. Metrological campaigns.
- Container atmosphere sampling methodology. Optimization of a "universal" measuring probe, comparing the performance of analytical tools available on the market.
- Ventilation efficiency. Provides real-time gas detection to define the efficiency and duration of container ventilation.
Preventing chemical risk during transport and unloading of shipping containers


Keller FX - Ventilation study for imported containers. 7th International Workshop – How to handle imported containers safely. Berlin (2014)

B Galland, Ph Lesné, N Monta
Our job: making yours safer
Thank you for your attention

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# Preventing chemical risk during transport and unloading of shipping containers

**Loss from occupational activity** - At all levels of the container transport chain

<table>
<thead>
<tr>
<th>Professional activity</th>
<th>Chemical products</th>
<th>Year</th>
<th>Location</th>
<th>Sign of acute intoxication</th>
<th>Sequel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ports</td>
<td>Customs (2)</td>
<td>2000</td>
<td>Le Havre</td>
<td>Headache, nausea</td>
<td>none</td>
</tr>
<tr>
<td>Dockers (2)</td>
<td>MB</td>
<td>2007</td>
<td>Rotterdam</td>
<td>Irritation of the respiratory tract and eyes, loss of consciousness</td>
<td>Neuropsychiatric disorder (2), Sensory disorder</td>
</tr>
<tr>
<td>Warehouseman (19)</td>
<td>MB (11), 1,2DCE (5), P(3)</td>
<td>2006-2010</td>
<td>Hamburg</td>
<td>Irritation of the respiratory tract and eyes, headache</td>
<td>Neuropsychiatric disorder (14)</td>
</tr>
<tr>
<td><strong>During transportation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Truck driver</td>
<td>MB</td>
<td>2012</td>
<td>Rotterdam</td>
<td>Irritation of the respiratory tract, vomiting</td>
<td>Neuropsychiatric disorder</td>
</tr>
<tr>
<td>Mover</td>
<td>P</td>
<td>2012</td>
<td>Paris</td>
<td>Eye irritation, headache, nausea</td>
<td>Neuropsychiatric disorder</td>
</tr>
<tr>
<td>On boat</td>
<td>Sailor</td>
<td>2008</td>
<td>Off Brest</td>
<td>Death</td>
<td></td>
</tr>
</tbody>
</table>

Spotting among potentially exposed professionals (survey, traceability, exposure)

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25/06/2018